

THE OCCURRENCE IN THE UNITED STATES OF  
CRYPTOCOCCUS FAGI (BAER) DOUGL., THE INSECT  
FACTOR IN A MENACING DISEASE OF BEECH

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THE BEECH SCALE, *Cryptococcus fagi*, has long been known in Europe as a common pest on *Fagus sylvatica* and its varieties. It has been found in practically every country of western Europe. Sporadically infestations have at times been followed by an extensive killing of Beech, but elsewhere no important damage has resulted. Studies on destructive epidemics have yielded some evidence that the immediate killing agents were certain fungi, species unable to secure a foothold on healthy uninjured bark, but capable of causing much damage if entrance has been made possible by the scale.

The first discovery of the scale in America was reported by Hewitt in 1914 on ornamental European Beeches and our native *Fagus grandifolia* in the vicinity of Halifax, Nova Scotia. Evidence was presented which indicated that it had been there since about 1890. Subsequent notes on its spread indicate that it is at present general throughout the Maritime Provinces of eastern Canada. But until now there has been no report of its having reached the United States.

In the earlier stages of the outbreak in Nova Scotia no serious damage to the Beech was noted, but eventually there set in a destruction of Beech on a wide scale and in alarming proportions. A pathological reconnaissance of the forests of Nova Scotia made in 1929 by Dr. J. H. Faull of the Arnold Arboretum, Harvard University, led him to conclude that the death of the Beech was immediately due to fungal action. A study of the problems involved was turned over to the writer in 1929, and is still in progress under the direction of Dr. Faull, supported by the National Research Council of Canada and the Arnold Arboretum.

RANGE IN THE UNITED STATES

Since the scale had not, apparently, been reported in the United States, an examination was begun of Beeches in the metropolitan district about Boston. In November, 1929, a light infestation of what appeared to be the Beech scale was found on the native Beeches in the Arnold Arboretum. In December, a more severe attack was discovered on some Beeches sheltered by Hemlocks in the Boston city park at Jamaica Pond. Some of this material was sent

to Dr. E. M. Patch and to Dr. Harold Morrison, both of whom independently stated that the insect was *Cryptococcus fagi*. The search was continued in the vicinity of Boston and infestations were located in several other places within the city, also in adjacent Brookline, and in Middlesex County. In the spring of 1931, the presence of the Beech scale in metropolitan Boston came to the attention of the United States Entomological Laboratory, Forest Insects Division, at Melrose Highlands, and the survey was continued by their staff, with the result that several additional outbreaks were located, ranging in Massachusetts from Gloucester on the north to the Blue Hills in Milton on the south, and westwards to Belmont and Newton. On November 5, 1931, a heavy infestation was found in Liberty, Maine, by members of the Melrose Highlands Laboratory. The age of the Boston attack cannot be stated with certainty; but its severity in isolated places and the comments of gardeners indicate that the insect has been present for approximately ten years.

#### IMPORTANCE

It cannot be prognosticated how widespread or serious the scale is likely to become; but the general fatality of infested Beeches in Nova Scotia and New Brunswick resulting from fungal attack suggests a potential danger of the first importance. Slime fluxes are not infrequent on the infested trees in Massachusetts as they are in the Maritime Provinces, but these seem to be of only minor significance. The species of fungus responsible for the death of the Maritime beeches has not been found in Massachusetts although the writer has examined a large proportion of all the trees in the region known by him to be infested.

#### LIFE HISTORY OF *CRYPTOCOCCUS FAGI*

The life history of *Cryptococcus fagi* was studied in Germany by Rhumbler (1915, 1922). He found that oviposition occurs from the middle of June to the end of October. The motile form I larvae hatch after a month, or longer in cooler weather. They are slender, 0.24–0.33 mm. in length, pale yellow in color, and equipped with active legs and five-membered antennae. These crawlers roam about the bark, generally in an upward direction, until a suitable resting place is found in a crevice of the bark, on the lower side of branches, or under the curly-threaded canopy of preceding generations. The stylets are inserted into the bark, the body increases in size to 0.35–0.38 mm., the legs lose their ability to move, exudation of white threads begins, and the insect is fixed in position for the remainder of its life. This change into the form II larva occurs in

the late autumn or the following February. Between April and July the form II larvae molt and become the nymphal form III, whose body length at first is 0.38–0.4 mm., whose legs are lacking, and whose antennae are two-membered. A second molt occurs soon after, followed by development into the egg-laying females, circular in outline and 0.5–0.8 mm. in size. Winged forms and males are lacking. The females oviposit periodically through the late summer and early autumn and die with the coming of the frosts. The life-cycle is thus annual.

The development of *C. fagi* in eastern America coincides with that in Europe. In Nova Scotia and New Brunswick, however, hatching does not begin until about the end of July and the crawlers stop roaming by the end of September. In Boston the period of larval activity is somewhat longer. Local dissemination of the insect is effected by wind-carriage of the crawlers and of bits of wool containing eggs, and within a beech stand by the travelling of the crawlers over the ground from one tree to another.

#### CONTROL

The beech scale does not seem to be a serious pest unless accompanied by certain fungi. Although that danger is apparently not yet present in the eastern United States, the surest way to forestall the possibility is to eradicate the scale. Obviously when once an insect such as this one becomes widely established in the woodlands, as it has in the Maritime Provinces, eradication is a very serious problem. But in Massachusetts, with a range still limited in area and restricted largely to ornamental situations, control seems not only feasible but greatly to be desired.

With a view to selecting an easily obtainable and effective insecticide for New England use, preliminary tests were made in the late winter of 1931 with different strengths of commercial Sunoco Oil, home-made kerosene-soap emulsion, nicotine sulphate (Black Leaf 40), and lime-sulphur. The tests were made by soaking an infested area of bark with the aid of a hand spray gun and removing samples of the bark at once and at intervals of several days for microscopic examination. The efficacy of the various materials was determined by placing the bark on the stage of a binocular and gently raising individual nymphs from the bark with a needle so as not to injure them while thus forcibly withdrawing their stylets from the bark. They were then rolled over so that their ventral sides were uppermost. Those not killed by the insecticide indicated their vitality by waving the stylets above their bodies. Others, raised slightly, but not sufficiently to cause complete withdrawal of the stylets from

the bark, would wave their bodies about, pivoted only on the stylets. A sufficient number of nymphs was examined in this way from every bark sample so as to leave no doubt as to the effect of a particular treatment. The results of these preliminary tests are summarized in Table I.

TABLE I. PRELIMINARY TESTS WITH CONTACT INSECTICIDES FOR CONTROL OF THE BEECH SCALE

Material	Strength	Place	Effective	Partially Effective	Not Effective
Kerosene-soap emulsion	25%	Arnold Arboretum	*		
Kerosene-soap emulsion	25%	Jamaica Pond		*	
Sunoco Oil	1-25	Jamaica Pond		*	
Sunoco Oil	1-5	Middlesex Fells	*		
Black Leaf 40	1-50	Jamaica Pond			*
Black Leaf 40	1-50	Middlesex Fells		*	
Black Leaf 40	1-25	Middlesex Fells		*	
Black Leaf 40 plus Sunoco Oil	1-25 1-15	Middlesex Fells	*		
Lime-sulphur	app. 5° B.	Jamaica Pond			*

These results indicate that lime-sulphur and nicotine sulphate are not satisfactory materials but that Sunoco Oil and kerosene-soap emulsion are suitable.

Later in the spring of 1931 field tests were made with commercial equipment operated by regular park employees in the Arnold Arboretum, the Boston Parks, and the Middlesex Fells Reservation, using Sunoco Oil, kerosene-soap emulsion, and nicotine sulphate. The pertinent results of these tests are brought together in Table II.

It was concluded from these results that Sunoco Oil, 1-15, is the most satisfactory material. The critical factor in these tests seemed to be the ability of the operator to cover the entire surface of the tree with sufficient thoroughness so that the material wet the fluffy canopy protecting the insects and penetrated to their bodies. This was possible only with the oils. A few trees were also scrubbed with each of these materials, using a long pole with a scrub-brush screwed to one end. It was found that this method, when used with Sunoco Oil or kerosene-soap emulsion, was much the most thorough. But it is a difficult method and the labor and expense

involved make it applicable only in estates where a small number of valued shade trees are to be kept completely free of the scale.

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TABLE II. FIELD TESTS WITH CONTACT INSECTICIDES FOR CONTROL OF THE BEECH SCALE

Material	Strength	Place	Number of Infested Trees Sprayed	Number of These Trees Scale-Free <sup>1</sup>	% Control
Sunoco Oil	1-15	Arnold Arboretum	15	15	100
Kerosene-soap emulsion	25%	Willow Pond Road, Boston	18	12	66 $\frac{2}{3}$
Sunoco Oil, soap, and Black Leaf 40	1-10 $\frac{1}{2}$ pint per 40 gallons	Middlesex Fells	69	69	100
water Black Leaf 40 soap	50 gallons $\frac{1}{2}$ pint 2 $\frac{1}{2}$ lbs	Jamaica Pond, Boston	9	0	0

<sup>1</sup> Number of these trees on which no living scale could be found on careful examination of accessible parts with a hand-lens a month after spraying.

### SUMMARY

The beech scale of Europe, present and spreading in eastern Canada for many years, has recently been found to be abundant on Beeches in the vicinity of Boston, Massachusetts, and has just been discovered in one locality in Maine. Beeches in eastern Canada are dying in vast quantities through the attacks of fungi which grow in scale-infested bark; but these fungi have not been found on Beeches in Massachusetts. The insect has an annual life-cycle; dissemination is effected by eggs and larvae during the summer and autumn. Experiments with contact insecticides point to the efficacy of thoroughly spraying ornamental trees with Sunoco Oil or kerosene-soap emulsion.

## REFERENCES CITED

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